

Using GEO Optical Observations to Infer Orbit Populations

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ABSTRACT

NASA's Orbital Debris measurements program has a goal to characterize the small debris environment in the geosynchronous Earth-orbit (GEO) region using optical telescopes ("small" refers to objects too small to catalog and track with current systems). Traditionally, observations of GEO and near-GEO objects involve following the object with the telescope long enough to obtain an orbit. When observing very dim objects with small field-of-view telescopes, though, the observations are generally too short to obtain accurate orbital elements. However, it is possible to use such observations to statistically characterize the small object environment. A telescope pointed at a particular spot could potentially see objects in a number of different orbits. Inevitably, when looking at one region for certain types of orbits, there are objects in other types of orbits that cannot be seen. Observation campaigns are designed with these limitations in mind and are set up to span a number of regions of the sky, making it possible to sample all potential orbits under consideration. Each orbit is not seen with the same probability, however, so there are observation biases intrinsic to any observation campaign. Fortunately, it is possible to remove such biases and reconstruct a meaningful estimate of the statistical orbit populations of small objects in GEO. This information, in turn, can be used to investigate the nature of debris sources and to characterize the risk to GEO spacecraft. This paper describes these statistical tools and presents estimates of small object GEO populations.